



## ON THE MACROTRACHELOUS CALLIDINÆ.

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(Read 15th January, 1892.)

## PLATE II.

I propose to put before you this evening a few remarks upon certain Bdelloid Rotifers, which I term the *Macrotrachelous Callidinæ*, and to conclude with brief descriptions of four new species.

The genus *Callidina* comprises, as is well known, those Rotifers of the *Philodinadæ* which possess no eyes, and is represented in the great Rotifer text-book by 10 admitted species, while seven others are referred to as doubtful or imperfectly described forms. For three of these last I claim readmission. The *Callidina constricta* of Dujardin is perhaps not satisfactorily described by the French Naturalist, but Mr. Milne has published a very thorough description of a form which he identifies with it, and he states expressly that Dujardin's figure is a very successful one. Indeed, if the species be not admitted on the original description, it must be on that of Milne, and so, too, must *C. musculosa*, as both species are of frequent occurrence, and easily identified from the characters given. As to the third form, *Callidina tridens*, I have not yet succeeded in identifying it, but I am not disposed on that account to consider doubtful a species so fully described by an observer who has given special attention to the genus. One other species of Mr. Milne's, *C. reclusa*, was described too late to be mentioned in the Supplement. These bring the total up to 14 species, and a fifteenth was recently brought before you by Mr. Parsons. If you further add the four species which I shall presently introduce to you, and still two others which will shortly be described by Mr. Percy Thompson, you will find that the humble and usually overlooked genus *Callidina* numbers no less than 21 species, of which at least 19 occur in this country. It has thus a certain numerical importance, but I

desire to show you that it is important from a higher point of view, viz., that the habits and life histories of various species present to us some very interesting biological studies, peculiar so far as is yet known to this one genus.

But which are the *Macrotrachelous Callidinæ*? On page 59 of the Supplement Dr. Hudson tells us that Milne proposes the genus *Macrotrachela* for three-toed *Philodinadæ*, having the pre-intestinal part of the body decidedly longer than the post-anal, and that all the species are *Callidinæ*. When this was written Dr. Hudson had probably not seen Mr. Milne's second article (No. 187 of the "Bibliography"), for in it was described a species, *Macrotrachela Roeperti*, very similar in habits and general structure to *Callidina reclusa*, but possessing two distinct eyes within the frontal column, and, therefore, technically not a *Callidina*. In this article, and *apropos* of these closely related species, Mr. Milne again urged the proposition made originally as regards the species now known as *Adineta oculata*, that Ehrenberg's classification of the *Philodinadæ* was unsatisfactory, insomuch as it associated species manifestly distant, while separating species as manifestly of a close relationship. To amend the position he proposed in his earlier paper a new arrangement of the genera, and among other suggestions brought forward the new genus *Macrotrachela*. To my mind this genus associates a very compact group of species, with a decided family likeness, and I should much like to adopt it, and to see it accepted, but the scheme involves the primary separation of the *Philodinadæ* into those having four toes and those having three toes, a character extremely difficult to detect, and, therefore, a bad one for such a purpose. Without going further into this matter, I have ventured, by the use of the term *Macrotrachelous*, to avail myself of the most valuable of Mr. Milne's suggestions, to denote those *Callidinæ* in which, when fully extended, the post-anal portion is decidedly shorter than the pre-intestinal.

Three species, *parasitica*, *socialis*, and *magnicalcarata*, do not possess this character, and these, therefore, do not fall within my subject matter. They have, however, one common point of interest, namely, that all three are ecto-parasitic upon other forms of animal life.

The remaining species are all *Macrotrachelous*. Their great

peculiarity is that by far the majority of them seem to have their habitat among, or upon, the stems, leaves, or bracts of various mosses. Specimens are rarely found in ordinary dip-pings, nor are they met with crawling over the leaves of the usually gathered water plants, and this is doubtless the reason why so little has been known about them. My own method of collection is both successful and very simple. Provided with several wide-mouthed bottles, with tightly fitting corks, I gather (with as little soil as possible) threads or stems of moss from old walls, from damp banks, from the bark of trees, from alongside pools, or, best of all, from tufts of *Sphagnum*. I take care not to pack the moss tightly, nor do I add water, for the moisture clinging about the moss is sufficient (in a well-corked bottle) to keep the *Callidinæ* alive for months, I presume in a succession of generations. This refers to moss gathered in a moist state, but if gathered from dry positions it may be slightly damped, no more. The store bottles (for which may be substituted tin canisters) should be kept in a cool room, and exposed to nothing stronger than a north light. When convenient I place a stem or two in a zoophyte trough, and add water. After a few minutes I move the moss briskly to and fro in the water, and then remove it. I place the trough in an inclined position, and when the water is sufficiently clear I remove it to the inclined stage of my microscope. A brief search with the one-inch power generally reveals specimens of several species of these *Callidinæ*, accompanied by *Adineta vaga*, and several species of the *Cathypnadiæ*.

I have not succeeded in locating any favourite lurking place of the apparently free-living species about the moss stems, but the forms *symbiotica* and *Leitgebii* are stated to make their home in certain cavities and corners formed on the under side of the leaves of four species of *Jungermannie*, and Dr. Hudson, in a very interesting passage, relates to us how, after reading Dr. Zelinka's account of their habit of life, he remembered where he had noticed some moss of one of these species, and having brought some home was delighted to find some of these *Callidinæ* inhabiting it in the manner described.\* These two forms, *symbiotica* and *Leitgebii*, have a special interest. They appear to

\* I have to thank Dr. Carl Zelinka for a copy of his instructive paper which he most kindly forwarded to me.

be constantly associated with these four species of moss, occurring in specimens gathered in the most remote districts of Germany and Austria, and at least in one case in England. But, further, this constant association has suggested that there is a certain benefit accruing to the moss-plants from their affording house-room to these *Callidinæ*, and that there is here a true case of symbiosis. We have, in other Rotifera, instances of both the complete and the partial parasitism. To use everyday language, some species are "full boarders," others are only "lodgers," yet neither class gives any return for benefits received. In *Callidina symbiotica* and *C. Leitgebii* we have, I think, the first species of Rotifera whose association with another organism has been supposed to be mutually advantageous.

There is no suggestion of symbiosis made with respect to *Callidina reclusa*, but its life-history is quite as remarkable. I may be allowed to bracket with it for the present purpose the species *Roeperi*, already mentioned, as having a similar habit of life. These two species live in the cells forming the outer layer of the stems of the small side shoots of *Sphagnum*. If you place under your microscope such a stem from which you have stripped the leaves you will see that this outer layer consists of elongate cells of some little size, and that many of them possess, usually at one extremity, an opening whose margin is sometimes rather elevated, and through which water may freely enter into the cell cavity. These peculiar cells are found by these Rotifers to be exceedingly convenient. There is sufficient space inside to allow them to turn about, and there is a suitable opening from which to protrude their heads when they are hungry, and desire to gather food supplies by the action of their trochal discs. They are protected both from sudden drought and from the attacks of roving enemies. They lay their eggs in the cells, and, indeed, it is probable that under ordinary conditions they rarely quit a cell in which they have once established themselves. They are to be found in nearly every piece of freshly gathered *Sphagnum* which may be examined, and I have succeeded in keeping a colony alive in captivity for some little time.

As far as I have yet seen, none of the other forms known to me can be said to prefer any one kind of moss to the exclusion

of others, but there is doubtless much to be learned yet both about this and the supposed symbiotic relations to which I have referred.

The form described by Mr. Milne as the *Callidina elegans* of Ehrenberg, and which I believe to be quite distinct from the species described by Mr. Gosse under the same name, is by no means uncommon. It usually appears in the trough as a restless wanderer, and will crawl about for hours without protruding its wheels. On one occasion I found a colony established in one of my jars, and I discovered that it had the habit of gathering around it, by the continued action of the wheels, a small heap of dirty floccose matter, similar to that made by *Rotifer macroceros*, but with this difference, that whereas the latter *Rotifer* usually perches upon a conferva thread or in the axil of some leaf, the *Callidina* appeared, in the absence of such convenient spots, to have simply gathered its little pile wherever it might happen to be. I found the little houses lying free among the sediment.

Mr. Milne has recorded some similar tube-dwelling specimens, but does not appear to have made out the species, and I am in the same position with regard to another series of individuals, which were neither the above-mentioned *C. elegans* nor any other of the forms familiar to me.

I have frequently kept specimens of both *constricta* and *quadricornifera* for many days in a trough, and have never observed in either the least approach to this tube-making habit. On the contrary, without being wild, they, and also *musculosa*, *lata*, and *plicata*, do not care to remain long at one spot. They readily protrude their wheels, and will continue feeding for some time, but presently, for some apparent reason, they withdraw their coronæ and march, caterpillar fashion, a very little way, and again commence feeding, and so on. Whether it be that they thus endeavour to avoid the accumulation of refuse about them, or that they find that they are attracting the same rejected particles over and over again; whether they are timid, or perhaps sensitive to the unaccustomed glare of light, I cannot say, but such is their behaviour when under observation. These five species are all moderately common and easily studied.

There are only two species which swim readily—these are

*musculosa* and a form which I take, but with great doubt, to be the *bihamata* of Gosse. Each has its own peculiar attitude and movement.

The other species confine themselves to crawling, mostly after the caterpillar fashion, common to the *Philodinadæ*, yet some with a peculiar modification of it noticed both by Gosse and Milne. It is a peculiar mixture of gliding and creeping, and it has been suggested to me that the usual movement of *Adineta* is of the same character. The effect is indeed the same, but it is produced by very different means. In *Adineta* the corona has been modified into a mere furring of a ventrally placed portion of the head, and the gliding motion is due to the action of the cilia which form the furring of this prone face. In these *Callidinæ* the corona is completely retracted during the progression, and the motion is due to a number of strong cilia which protrude from the hollow tip of the frontal column when fully extended, as in crawling. Thus, so soon as the toes leave hold of the glass, these cilia, by their action on the opposing surface, drive the Rotifer forward until the toes can again fasten themselves. The species in which the cilia of the column are so powerful as to produce this gliding movement, possess therein a method of progression distinct from that of any other Rotifers known, in arising from the action of cilia which have no connection either with the corona or with the buccal orifice.

Another curious peculiarity of some of these forms is their treatment of the food particles after these have passed beyond the mastax. In *constricta* and some others the food is then formed into small pellets, suggestive of those seen in *Paramecium*, but probably moulded in an œsophagus; and the capacious stomach presents a very peculiar appearance when filled with these pellets. An alternate heaving motion provides the necessary agitation of the food. In other species the alimentary canal can be more readily seen to be a long tube in which the food, not moulded into pellets, is agitated by powerful cilia. In some cases I have not been able to detect the presence of cilia at all.

It would be unfitting to attempt here even a brief description of the structure of one of these *Callidinæ*, but as I should wish these notes to have more than a passing interest, I will very shortly indicate some points to which a student should pay par-

ticular heed, and I can predict that he will be astonished at the well-marked individualities which he will find to exist.

Commencing with the trochal discs, he should note their breadth, relative distance, height from secondary wreath, and proportion to breadth of head; the positions in swimming, feeding, crawling, partial retraction, and complete retraction; the shape of the rami, and the number of teeth on each, taking care that he does not mistake fine teeth for the fine striæ frequently present; the structure of the frontal column and the membranous shielding flap with which the tip is provided, and which might be mistaken for two hooks; the antenna, its length and direction; the skin, its folds, surface, and pseudo-armature. The foot should be considered as including only the post-anal segments. The spurs, though usually short, are very distinctive, and the toes very difficult to see at all, far less define and count. The treatment of the food and the various movements assisting the digestive action should be watched while the animal is feeding. Above all, sketches should be made and copious notes taken at every opportunity.

Before mentioning the characters of the four new species I wish to say that I have not been able to identify, to my own satisfaction, any of the *Callidinæ* described by Mr. Gosse, and that if anyone here can furnish me either with specimens or with further particulars of these species he will confer upon me a very great favour.

*Callidina plicata*, n. sp.

*Sp. Ch.*—Elongate and without medial swelling when crawling. Central portion of trunk with coarse dorsal and lateral skinfolds, mostly extending forward over anterior portion and the central dorsal pair extending over posterior segment, the latter, conspicuously swollen and hood-like, constricted at upper and near lower end. Foot only displayed when crawling. Spurs moderately stout and short cones, with slightly produced points, showing (rarely) narrow interstice when at greatest separation. Wheels rather large; mastax ample, rondo ovate, two teeth on each ramus.

Intestinal action a periodic heaving, food not moulded into pellets.

It is possible that the hood-like segment, apparently consist-

ing of one joint, is, in reality, a modification of the two ultimate trunk joints.

Length—Extended about  $\frac{1}{80}$  inch.

Habitat—Among *Sphagnum* and other mosses. Epping Forest and Isle of Wight. Common.

*Callidina lata*, n. sp.

*Sp. Ch.*—Very short and broad, central portion of trunk much flattened, broadest behind the middle, suddenly narrowing to posterior segment. Dorsal skinfolds obsolete, lateral very deep. When feeding posterior trunk segment about one-third width of central portion. Foot slender, spurs slender, acute and of moderate length without interstice. Wheels rather small, about width of head. Food moulded into coarse pellets. Mastax pyriform, three teeth on each ramus. Column furnished with rather long cilia.

The peculiar breadth and squareness of the central portion of the trunk is usually apparent even in crawling. Occasionally, however, a specimen will present, for a moment, the facies of a *Philodina*. In complete retraction it assumes the form of a broad ellipse whose greatest length is transverse to the body axis. A rather small form, yet varying much in size, large specimens about  $\frac{1}{125}$  inch when extended. It crawls rather slowly, yet with a slight gliding motion as described above. I have thought that I could detect a few setæ at tip of column as well as the usual cilia.

Habitat—Among *Sphagnum* and other mosses. Epping Forest, Folkestone, and Isle of Wight. Scarcely so common as the last.

*Callidina spinosa*, n. sp.

*Sp. Ch.*—Longitudinal skinfolds and those marking trunk segments armed with very short prickle-like points set closely together, the angles marked with rather longer points. A short spine on centre of ventral margin and a longer one at each lateral angle of anterior edge of first trunk segment, Spurs rather long and of peculiar shape, at first parallel, they are bent outwards at a right angle and thence incurved, so that each describes a  $\frac{1}{4}$  circle, the points being directed downwards and backwards.

I only found one specimen of this peculiar form; it was ex-



ceedingly timid and would scarcely extend itself, far less commence feeding. The cuticle was dense, and I could not get at internal details, nor could I count with certainty the number of teeth on each ramus. When extended it had rather the outline of a *Philodina*, but I could not detect any eyes. As the head and neck were protruded the lateral spines became depressed, falling close to the sides. The spurs have a distinct resemblance to the toes of *Taphrocampa selenura*, and were each nearly  $\frac{1}{300}$  of an inch in length, that of the whole animal extended being estimated at about  $\frac{1}{40}$  of an inch.

Habitat—Among *Sphagnum* from Sandown, Isle of Wight.

*Callidina aspera*, n. sp.

*Sp. Ch.*—Longitudinal folds of trunk, both dorsal and ventral, beset with closely set blunt points. Mastax rondo-ovate with two teeth on each ramus. Spurs small cones, just longer than thickness at base. Of a brownish colour. Wheels rather small, scarcely wider than head.

Several specimens found among Hypnum given to me by Mr. Thompson, and gathered by him in Epping Forest.

Length about  $\frac{1}{25}$  inch extended.

Habitat—As above.

DESCRIPTION OF PLATE II.

Fig. 1.—*Callidina plicata*, wheels protruded, dorsal view.

1a. Foot extended as in crawling, lateral view.

1b. Ditto, ditto, dorsal view.

„ 2.—*Callidina lata*, wheels protruded, dorsal view.

„ 3.—*Callidina spinosa*, retracted, ventral view. 3a.

Spurs.

„ 4.—*Callidina aspera*, wheels protruded, dorsal view.